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Estimating the effect of the EMU on current account balances: A synthetic control approach

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ABSTRACT

The European sovereign debt crisis wrought major political and economic damage on the European Monetary Union (EMU). This led to a reassessment of the pre-crisis period of economic growth and stability in the EMU, shifting attention to the macroeconomic imbalances that emerged between member states, especially those in current account balances. This paper uses macroeconomic data on OECD economies and a new statistical approach for causal inference in observational studies—the synthetic control method—to estimate the effect of the EMU on the current account balances of individual member states. This 'counterfactuals' approach provides strong evidence that the introduction of the EMU was responsible for the divergence in current account balances among member states in the run-up to the euro crisis. The results suggest that the EMU effect operated through multiple channels and that fundamental changes to the institutional framework of the EMU may be required to safeguard the currency union against a reemergence of dangerous external imbalances in the future.

Keywords:
Common currency areas
EMU
Current account balances
Synthetic control method
European sovereign debt crisis

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1. Introduction

The European sovereign debt crisis (hereby referred to as the euro crisis) put severe economic and political strain on the European Monetary Union (EMU) and even cast doubt on the future of the wider European project. The no-bail-out clause enshrined in the Treaty of Rome (1957) was broken multiple times, harsh austerity measures plunged the periphery of the currency union into a prolonged recession and political tensions rose both within and between member states.[1]

The euro crisis prompted a reassessment of the EMU, which had been labeled a "resounding success" by the European Commission (2008, p. 3) after its first decade. When countries joined the EMU and adopted the euro they relinquished control of monetary policy to the European Central Bank (ECB) who assumed responsibility for stabilizing member state economies following economic disturbances. While the ECB achieved its main policy goal—average euro area inflation was just above the Bank's 2% target between 1999 and 2008—, the narrow focus on average inflation masked significant divergence among member states. The period after the introduction of EMU up until the euro crisis was characterized by differentials in inflation, but also in growth, real exchange rates and current account balances (Carlin, 2013; Lane, 2006).

This paper focuses on the current account imbalances that emerged among EMU member states prior to the euro crisis. On the tenth anniversary of the EMU in 2008, current account balances ranged from -14.5% of Gross Domestic Product (GDP) in Greece to 5.6% of GDP in Germany.[2] The current account balance is defined as the trade balance (export minus imports) plus net interest and profit receipts from abroad (Carlin and Soskice, 2015, p. 352). It captures inflows and outflows of both goods and services and investment income. Iversen et al. (2016) show that the EMU's current account imbalances had a distinct geographical pattern, with the southern European economies (and Ireland) amassing substantial deficits and the northern European economies amassing substantial surpluses, and that they were self-reinforcing, with the northern economies trade surpluses being reinvested into the fast-growing southern economies (see also Hall, 2012).

If a country is running a current account deficit it signals that they are a net borrower from the rest of the world. Persistent current account deficits therefore signal rising external indebtedness, which can reflect the accumulation of government debt (as in Greece and Italy), private sector debt (as in Ireland and Spain), or a combination of the two (as in Portugal). Sizeable external deficits can pose serious economic problems. To the extent that they reflect the overheating of the nontradables sector they can damage the competitiveness of the export sector. This problem is particularly acute in a currency union (such as the EMU) because of the inability to devalue the nominal exchange rate to restore competitiveness. Large current account deficits also make economies more vulnerable to external economic shocks because of the risk of a sudden stop in the capital inflows financing the deficit (Lane, 2012).

[1] The Treaty of Rome was signed in March 1957 and is officially known as the Treaty establishing the European Economic Community (TEEC). For more information on EEC/EU treaties, see: http://europa.eu/eu-law/decision-making/treaties/index_en.htm

[2] Source: IMF World Economic Outlook database, October 2015.

The global financial crisis of 2008-09 shook financial market confidence, making investors reluctant to lend to the EMU's deficit countries and pushing up their government bond yields (Sturm, 2011; von Hagen et al., 2011). This escalated into a sovereign debt crisis due to unique features of the EMU; the lack of a credible lender of last resort and the lack of a banking union (De Grauwe, 2013; Iversen et al., 2016; Moro, 2014). However, it is clearly no coincidence that the countries that on average ran current account deficits during the first decade of EMU—Italy, Ireland, Spain, Greece and Portugal—were those that later became embroiled in the euro crisis (Brancaccio, 2012; Carlin, 2013).

This paper investigates the extent to which the introduction of the EMU was responsible for the current account imbalances that emerged between member states in the 2000s. Given the role that current account imbalances played in the euro crisis it is crucial to the next generation of euro area policymaking that the part played by the EMU (and its institutional framework) in driving the imbalances is better understood. As Bertola et al. (2013) clearly state, any credible strategy for getting the EMU back on track needs to address the balance-of-payments crisis as well as the sovereign debt and banking crises.

My study uses a new statistical approach for causal inference in observational studies—the synthetic control method (Abadie and Gardeazabal, 2003; Abadie et al., 2015, 2011, 2010)—to investigate the effect of the EMU on the current account balances of individual member states. The method constructs counterfactuals, or 'synthetic control units', which show what would have happened to the current account balances of member states had they not joined the EMU. The synthetic control units are constructed as a weighted average of OECD countries outside of the EMU. The difference between the actual current account balances of member states and their synthetic counterparts provides an estimate of the causal effect of the EMU on the current account balances.

The synthetic control method has previously been used to assess the economic benefits of the EU (Campos et al., 2014), the impact of the Stability and Growth Pact on government debt in euro area countries (Koehler and König, 2015) and the effect of the EMU on GDP per capita (Fernández and Perea, 2015) and real exchange rates (El-Shagi et al., 2016). To the best of my knowledge, this is the first time this approach has been used to study the effect of the EMU on current account balances. The synthetic control method has several advantages over traditional cross-country regressions and comparative case studies. First, the counterfactuals-based approach allows us to directly estimate the 'causal effect' of the EMU on current account balances. Second, the control units are created using a transparent and data-driven procedure, which is often not the case in comparative case studies (Abadie et al., 2015, p. 2). Lastly, the method avoids the model-dependent extrapolation that is common in regression-based analyses (Abadie et al., 2015, p. 3; King and Zeng, 2006).

The rest of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature on the EMU and current account balances. Section 3 sets out the synthetic control methodology. Section 4 presents the results of the synthetic control analysis. Section 5 presents a number of placebo and robustness checks. The final section provides some concluding remarks.

2. Literature review: The EMU and current account balances

A rich literature on the macroeconomic effects of the EMU has emerged since the euro was introduced in 1999. Previous studies have investigated the effect of the EMU on a whole range of economic indicators, such as trade (Baldwin, 2006; Baldwin et al., 2008; Bun and Klaassen, 2007; Micco et al., 2003), foreign direct investment (De Sousa and Lochard, 2011; Petroulas, 2007), cross-border banking (Blank and Buch, 2007; Coeurdacier and Martin, 2009; Spiegel, 2009), real exchange rates (El-Shagi et al., 2016), GDP per capita (Fernández and Perea, 2015), and wage growth and unemployment (Grüner, 2010; Mikosch and Sturm, 2012). Mongelli and Vega (2006) provide an overview of the early literature on the effects of the EMU on economic performance, financial structures and product and labor market institutions.

A large number of scholars have also studied the effect of the EMU on current account balances. Starting with the theoretical side, the literature has identified three main channels through which the EMU contributed to current account divergence among member states. The first is the *competitiveness* channel. The EMU fixed exchange rates between member states and removed the ability of countries to devalue to restore external competitiveness. It is also well documented that the wage-setting institutions of EMU member states vary greatly in their capacity to restrain wage growth, particularly in sheltered sectors (Hancké, 2013; Johnston et al., 2014). The divergence in real unit labor costs among member states under EMU therefore led to differences in the price competitiveness of their products on world markets and the emergence of current account imbalances between the north and south of the currency union (Hall, 2014, 2012; Iversen et al., 2016).

The second channel is the *financial integration* channel. The EMU furthered integration in banking and capital markets and dramatically reduced the borrowing costs for the less-creditworthy member states in the south. This increased capital flows from the north to the south, leading the former to accumulate current account surpluses and the latter to accumulate current account deficits (Bertola et al., 2013; Hale and Obstfeld, 2016). Current account imbalances fuelled by cross-border borrowing can be viewed as benign if they reflect a reallocation of resources from high-income countries with abundant capital to low-income countries with better growth prospects and investment opportunities (Blanchard and Giavazzi, 2002). However, they can be a cause for concern if the capital is channeled into sectors that do not improve the productive capacity of the economy (such as real estate) or if they delay the pace of necessary but politically costly structural reforms (Fernandez-Villaverde et al., 2013; Lane, 2012).

The final channel is the *fiscal deficit* channel. The Stability and Growth Pact (SGP) was introduced alongside the EMU. It set out the restrictions on the deficits and debt that member state governments could accumulate. However, its weak enforcement mechanisms and the lack of constraints on fiscal policy during upswings led to both expansionary fiscal stances in boom times and the return of politically-motivated fiscal boosts in election years (Buti and Van Den Noord, 2004; Efthyvoulou, 2012; Mink and De Haan, 2006). The threat of politically costly reprimands and fines that came with the SGP also increased the incentives of

politicians to underplay the size of budget deficits in official forecasts, especially in the lead up to elections (Brück and Stephan, 2006). Fiscal policy shocks can lead to an appreciation of the real exchange rate if they raise the demand for nontradable goods relative to tradable goods, which then worsens the current account balance (Abbas et al., 2011). This crowding out of net exports is compounded if the central bank reacts to the fiscal stimulus by raising the real interest rate (to keep inflation at target) (Carlin and Soskice, 2015).

Ample empirical evidence has been found to support the three channels highlighted by the theoretical literature. Arghyrou and Chortareas (2008) and Belke and Dreger (2013) investigate the effect of differences in external competitiveness on the current account balances of EMU member states and find a significant negative relationship between real exchange rates and current account balances. Schmitz and von Hagen (2011) and Hale and Obstfeld (2016) find evidence that the EMU significantly increased capital flows from the relatively richer northern member states to the relatively poorer southern member states. There are also a number of empirical studies that find that the EMU led to an increase in expansionary and electorally-motivated fiscal policy (Buti and Van Den Noord, 2004; Efthyvoulou, 2012; Mink and De Haan, 2006), as well as a rise in overly optimistic budget deficit forecasts aimed at misleading electorates, especially in the run up to elections (Brück and Stephan, 2006). In turn, there is also robust evidence that fiscal policy expansions in EMU countries result in a deterioration in the trade balance (Beetsma and Giuliodori, 2010; Bénétrix and Lane, 2010).

In contrast to the large body of literature that the EMU drove the current account imbalances between member states, some recent contributions find that factors external to the EMU also played an important role. Chen et al. (2013) and Guerrieri and Esposito (2013) find evidence of several external trade shocks—the sharp rise in oil prices, the emergence of China as a major exporter of low-value added manufactured goods and the movement of Continental European production chains to Central and Eastern European countries—that affected the northern and southern EMU member states differently during the 2000s, and hence contributed to the current account imbalances.

The empirical literature on the EMU's current account imbalances is plentiful but currently fails to get to the bottom of the extent to which the EMU was responsible. The synthetic control method used in this paper is uniquely suited for addressing this gap in the literature as it allows us to estimate how much of the current account balance changes were caused by the EMU and how much were driven by external factors.

3. Methodology: The synthetic control approach

The synthetic control method provides a rigorous quantitative framework for carrying out comparative case studies in political science (Abadie and Gardeazabal, 2003; Abadie et al., 2015, 2011, 2010). The method uses data driven procedures to construct a control unit from a pool of potential control units, such that the "synthetic control unit" best approximates the "most relevant characteristics of the unit exposed to the event of interest" (Abadie et al., 2010, p. 494). The approach is a significant improvement on other procedures for selecting control countries in comparative case studies, which often rely too heavily on

researchers' subjective measures of affinity between countries (Abadie et al., 2010, p. 493). The rigorous, quantitative way in which the control unit is chosen gives us more confidence the results can be interpreted as the causal effect of the event of interest.

In my case the event of interest is the introduction of the EMU. The countries that joined the EMU adopted the euro, but they also saw other institutional changes, such as the ceding of control of monetary policy to the ECB and the introduction of the SGP, which restricted member state governments' control over macroeconomic policy. This study uses the synthetic control methodology to produce counterfactual current account balances for individual member states showing what would have happened had they not joined the EMU. It then looks at the difference between the actual and counterfactual series to quantify the causal effect of joining the EMU.

I start by formally setting out how the synthetic control is constructed. At this stage I describe the process in general for a 'country of interest'. I will discuss which EMU member states have been selected for my study, and why, at the start of Section 4.2. I have a sample $J + 1$ countries, where unit $j = 1$ is the country of interest, and units $j = 2$ to $J + 1$ are the potential control units. In this case, my sample size is 16 and the 15 potential control countries are a sample of OECD economies that did not join the single currency. These potential control units are referred to as the 'donor pool' and are discussed in more detail in the next section. I initially assume that I have a balanced panel dataset, which varies across $J + 1$ countries and T time periods. In addition, T is split into two times periods, T_0, representing the pre-EMU period and T_1, representing the post-EMU period. In my case, I have data from 1980-2010 and the EMU was introduced at the start of 1999, so T_0 runs from 1980-1998 and T_1 runs from 1999-2010. The pre-EMU and post-EMU periods differ only for Greece, which joined the EMU at the start of 2001.

The aim of the synthetic control method is to create a control unit that best replicates the pre-EMU characteristics of the country of interest, but did not experience the event being tested (i.e. did not join the EMU). As there is no one country that exactly resembles the country of interest, but did not join the EMU, it will be more accurate to use a weighted average of a number of non-EMU countries from the donor pool. The synthetic control method is the approach used to find these weights, which I shall term $W = (w_2, \ldots, w_{J+1})'$, where, $0 \leq w_j \leq 1$ for $j = 2,...,J+1$ and $w_2 + ... + w_{J+1} = 1$. Hence W is the (J x 1) vector of country weights that are used to construct the synthetic control unit. The synthetic control unit can then be compared to the country of interest in the outcome variable (current account balance as a % of GDP) in the post-EMU period to estimate the causal effect of joining the EMU.

Following Mill's Method of Difference, Abadie et al. (2015, p. 3) suggest that the country weights should be selected such that the pre-EMU characteristics of the synthetic control unit best match those of the country of interest. In this application, only those characteristics that influence the current account balance should be relevant to selecting the optimal weights, W^*. I therefore define X_1 as a (k x 1) vector of pre-EMU current account balance predictors for the country of interest. These 'predictors' are macroeconomic variables that are known to influence the current account balance. The predictors will be discussed in more

detail in the next section. I then aim to match these as well as possible to a matrix of pre-EMU current account balance predictors for the donor pool. I define this as X_0, which is a (k x J) matrix. The vector $X_1 - X_0W$ then defines the difference between the country of interest and each country in the donor pool for each of the pre-EMU current account predictors. The vector of optimal weights, W^*, is defined by

$$W^* = \underset{W}{\operatorname{argmin}}[X_1 - X_0W]'v[X_1 - X_0W], \qquad (1)$$

where v is a (k x k) matrix showing the relative importance of each current account balance predictor in minimizing the equation.

It is clear that v will have a large effect on W^*. It is therefore important that those current account balance predictors that have the most power in determining the current account balance of the country of interest should be given the most weight. I use the technique proposed by Abadie and Gardeazabal (2003, p. 128) for selecting v, which chooses the current account balance predictor weights such that the resulting synthetic control unit best reproduces the trajectory of the current account balance of the country of interest in the years before the introduction of the EMU. More formally, v^* is defined by

$$v^* = \underset{v \in V}{\operatorname{argmin}}[Z_1 - Z_0W^*(v)]'[Z_1 - Z_0W^*(v)], \qquad (2)$$

where V is a set of all non-negative diagonal (k x k) matrices, Z_1 is a (T_0 x 1) vector of pre-EMU current account balances for the country of interest and Z_0 is a (T_0 x J) matrix of pre-EMU current account balances for the donor pool. The equation is subject to the constraint that $v^* = 1$, such that the optimal weights for the synthetic control are given by $W^* = W(v^*)$.

The last step in the process is to retrieve the treatment effect (i.e. the effect of the EMU on the current account balance of the country of interest). I define Y_1 as a (T_1 x 1) vector of post-EMU current account balances for my country of interest and Y_0 as a (T_1 x J) matrix of post-EMU current account balances for the donor pool. The effect of the EMU is simply the difference between the actual current account balance of the country of interest and that of the synthetic control unit in the post-EMU period. The effect of the EMU is therefore defined as $Y_1 - Y_1^*$, where $Y_1^* = W^*Y_0$.[3]

The central testable assumptions of the synthetic control method are that the synthetic control unit matches the country of interest well on current account balance predictors and that it can closely replicate the trajectory of the country of interest in the outcome variable (i.e. the current account balance) in the pre-EMU period. Unlike the closely related difference-in-difference method, however, you do not also need to assume that the effect of unobserved factors on the current account balance are constant over time. Put another way, the model allows for time-varying confounders at the country level. The generalization does

[3] The synthetic control analysis in this paper is a partial rather than a general equilibrium empirical model, which means that it does not take into account the knock-on effects on the donor pool countries of a country of interest not joining the EMU. The synthetic control method cannot be undertaken without this simplification because it relies on the Stable Unit Treatment Value Assumption (SUTVA) to make causal inferences, which assumes that there are no interferences between units (Rubin, 1980).

come with a price; however, as it means assuming linear relationships between outcomes in the post- and predictors in the pre-EMU period.

Abadie et al. (2015, p. 4) state "if the number of preintervention periods in the data is large, matching on preintervention outcomes helps control for unobserved factors and for the heterogeneity of the effect of the observed and unobserved factors on the outcome of interest". In other words, the country of interest and it synthetic counterpart could only produce similar trajectories in current account balances over the long pre-EMU period if they were alike in both observed and unobserved current account balance predictors. Therefore, if the pre-EMU trends in current account balances for the country of interest and its synthetic control unit are close enough before the introduction of the EMU, and I assume there are no confounding factors that emerge during the post-EMU period and affect my country of interest differently from those in donor pool, I can put any deviation after the EMU is introduced down to the EMU itself.

Member states made a decision to join the EMU, whereas some countries in the donor pool (e.g. Denmark, Sweden and the UK) had the option to join but chose not to. This can pose a problem when estimating the effect of the EMU using statistical methods. In an ideal world, some countries would have randomly joined the EMU and others would not have, mitigating any potential biases in estimating its effect. This is clearly not what happened. The synthetic control methodology sidesteps the issues associated with member states 'selecting into' the EMU, however, because it does not require exogenous assignment to treatment; it only assumes that the time-point of adoption is exogenous. The synthetic control units are constructed to match my countries of interest as closely as possible on observed and unobserved factors that affect the current account balance in the pre-EMU period. This means that, for member states, any factors that might have influenced their decision to join the EMU and their current account balance (i.e. potential sources of selection bias) are taken into account when constructing the synthetic control units.

4. Empirical analysis and results

4.1. Data

The data sample used for the study is an annual country-level panel dataset that covers the period from 1980-2010. The EMU was introduced in 1999, which gives a pre-EMU sample running from 1980-1998 and covering 19 years. The post-EMU period runs for 12 years from 1999. The only exception is Greece, which joined the EMU at the start of 2001; the pre-EMU period for Greece ends in 2000 and the post-EMU period begins in 2001.

The post-EMU period ends in 2010, which is the beginning of the euro crisis (the bailouts started from mid-2010 onwards). This allows us to assess the effect of the EMU on current account balances during the successful first decade of the single currency as well as during the global financial crisis. The time period fits with the main aim of the paper, which is to assess the effects of the EMU on current account balances in the run up to the euro crisis. However, there is also an important methodological reason for ending the post-

EMU period in 2010. The euro crisis represents a large structural event that affected the current account balances of individual OECD economies to varying degrees. While it is plausible that the global financial crisis affected all OECD economies, it is clear that some of the donor pool, such as countries with close trade relationships with EMU countries or large holdings of EMU sovereign bonds, were more exposed to the euro crisis than others. The euro crisis therefore represents an asymmetric shock to OECD current account balances and including the years after 2010 in the analysis would risk confounding my estimates of the EMU's effect.

The donor pool for the synthetic control analysis is composed of 15 OECD countries that did not join the EMU: Australia, Canada, Chile, Denmark, Hungary, Israel, Japan, Korea, Mexico, New Zealand, Poland, Sweden, Turkey, the UK and the US.[4] The donor pool only includes OECD countries, as it is important to "restrict the donor pool to units with outcomes that are thought to be driven by the structural process as for the unit representing the case of interest" (Abadie et al., 2015, p. 3). The countries of interest in my study are all OECD members, making them economically and politically comparable to the donor pool. The non-EMU OECD countries are therefore a suitable control group for the study. Following El-Shagi et al. (2016), the donor pool comprises both high- and middle-income countries to increase the likelihood that all the current account predictors of the countries of interest can be well matched.[5] This is particularly important given that some EMU member states, notably Greece, Portugal and Spain, had considerably lower living standards than the high-income non-EMU OECD countries upon joining the single currency.

In order to guard against confounding the estimates of EMU's effect, countries were not included in the donor pool if they were "subject to structural shocks in the outcome variable during the sample period of the study" (Abadie et al., 2015, p. 3). Norway and Switzerland were therefore excluded from the donor pool because they experienced large current account balance shocks during the post-EMU period. Norway's current account surplus jumped from 5.5% to 14.7% of GDP between 1999 and 2000, driven by an exogenous shock to the oil price. The price of Europe Brent crude oil tripled between January 1999 and September 2000.[6] Switzerland current account surplus collapsed from 10.8% to 3% of GDP between 2007 and 2008.[7] This reflected Switzerland's heavily finance-orientated economy (much more so than any EMU member state in the study) and the huge losses that the Swiss banking system took on their foreign subsidiaries during the financial crisis (SNB, 2009). The dramatic structural shock to the Swiss current account balance in 2008 shows the uniquely high exposure of the Swiss current account balance (among my sample) to a shock in global financial markets, and ultimately their unsuitability as a donor country.

[4] Following Abadie et al. (2015), I do not include Iceland in the donor pool due to its small size and unusual economic structure.
[5] As additional robustness tests, I also carry out the synthetic control analysis with two modified donor pools. The first excludes the five middle-income countries: Chile, Hungary, Mexico, Poland and Turkey. The second adds two non-EMU non-OECD countries that accumulated large current account deficits during the 2000s: Bulgaria and Romania. The results are shown in Figs. B1 and B2 in Appendix B. The main results of the paper are robust to using these alternative donor pools.
[6] *Source*: US Energy Information Administration.
[7] *Source for Norwegian and Swiss current account balances*: IMF World Economic Outlook Database, October 2015.

The outcome variable in the analysis is the current account balance (as a per cent of GDP). The current account balance predictors in the analysis are a set of macroeconomic variables that are known to influence the current account balance. They have been selected based on the literature on current account balances and the EMU set out in Section 2 and the previous empirical literature on the economic determinants of current account balances (see for example Chinn and Prasad, 2003; Gruber and Kamin, 2007; Schmitz and von Hagen, 2011). I account for the competitiveness channel by including measures of the price level of exports (relative to the US) and trade openness (%). I account for the financial integration channel by including measures of total investment (as a % of GDP), domestic credit to the private sector (as a % of GDP), GDP per capita (PPP) and GDP growth (%). These variables cover both the benign catching up scenario where credit flows from rich to poor countries and the credit bubble scenario where capital inflows are channeled into unproductive sectors. I account for the fiscal deficit channel by including measures of public debt (as a % of GDP) and the government primary balance (as a % of GDP). In addition to these variables, I also include a measure of domestic demand growth (%), which Belke et al. (2015) show is important in explaining exporting dynamics and consequently current account balances in the countries that ran persistent current account deficits in the post-EMU period (France, Greece, Italy, Portugal and Spain).

All current account predictors are available for the entire pre-EMU period (1980-1998), apart from GDP growth (1981-1998), total investment (1984-1998), public debt (1986-1998), government primary balance (1990-1998) and domestic credit to private sector (1991-1998). The current account predictors are averaged over the pre-EMU period as part of the estimation process (see Section 3), so it does not pose a problem for the analysis if they are not available for entire pre-EMU period. The data for the analysis were collected from the IMF, the World Bank and the Penn World Tables (see Table A1 in Appendix A for a full list of definitions and data sources).

4.2. Country selection

As mentioned in the Section 3, one of the central testable assumptions of the synthetic control method is that the synthetic control unit can closely replicate the pre-EMU current account balance trend of the country of interest. Only in the cases where this assumption holds can I be confident of obtaining causal estimates of the EMU's effect. In order to test whether the assumption holds, I carry out the synthetic control analysis described in Section 3 for all the founding EMU member states (except for Luxembourg) and Greece (which joined in 2001).[8] Table 1 reports the mean squared prediction errors (MSPEs) in the pre-EMU period, which measure of closeness of fit (lower numbers indicate a better fit) between the current account balances of the EMU member states and their synthetic control units.

The table shows that the closeness of fit varies widely across countries, ranging from 0.63 in France to 10.04 in Portugal. It is unsurprising that the method does not produce good synthetic control units for all

[8] The synthetic control analysis was carried out in R using the Synth package. As in Abadie et al. (2015) and El-Shagi et al. (2016), Luxembourg is excluded due to its small size and its unusual economic structure.

EMU member states; as the method creates a control unit from a convex combination of countries in the donor pool, it is unlikely to work for all countries, especially those that have pre-EMU current account balance trends that are more extreme than the countries in the donor pool.

Table 1.
Country selection: Pre-EMU MSPEs between EMU member states and their synthetic control units

	Pre-EMU MSPE		Pre-EMU MSPE
Austria	**1.52**	Ireland	6.55
Belgium	4.41	Italy	**0.87**
Finland	3.87	Netherlands	3.94
France	**0.63**	Portugal	10.04
Germany	3.75	Spain	**1.19**
Greece	**2.08**		

Note: The pre-EMU period runs from 1980-1998 in all countries except Greece, where it runs from 1980-2000. The figures in bold are those under the 2.5 threshold for inclusion in the main synthetic control analysis. *Source*: Author's calculations.

In order to restrict the analysis to the cases where the central assumption holds, I select only those member states where the pre-EMU MSPE is below 2.5 (shown in bold in Table 1). Hence the synthetic control analysis in the paper covers five countries: Austria, France, Greece, Italy and Spain. This country selection approach is similar to the approach taken by Billmeier and Nannicini (2013), who use a pre-treatment root MSPE threshold as a criterion for deciding which synthetic control results to present graphically in their paper.

The threshold of 2.5 seems a reasonable upper limit on pre-EMU trends *closely* matching. As we shall see in Section 4.4, the current account balances of the synthetic control units for the five countries under the threshold closely track their actual current account balances in the pre-EMU period. In addition, the first member state above the threshold (Germany) has a MSPE nearly twice as large as the first member below the threshold (Greece); hence, the closeness of fit in the pre-EMU period worsens considerably once we go beyond the five member states with the lowest MSPEs.

4.3. The synthetic control units

The synthetic control analysis involves choosing the country weights (W^*) such that the weighted average of the control units best reproduces the current account balance predictors of the countries of interest in the pre-EMU period. Table 2 shows the weight each country in the donor pool takes in the synthetic control units of the five countries my study focuses on. We can see from the table that, for example, Synthetic Austria is a convex combination of Australia (21%), Hungary (18%), Japan (39%), Korea (1%) and Poland (21%), with all other countries in the donor pool receiving a weight of zero. The country weights are different for each country of interest because they have different values for the current account predictors (and different current account trajectories) in the pre-EMU period.

Table 2.
Weights for synthetic control units

	Synthetic control weight				
	Synthetic Austria	Synthetic France	Synthetic Greece	Synthetic Italy	Synthetic Spain
Australia	21%	-	30%	-	9%
Canada	-	-	-	15%	-
Chile	-	-	-	-	1%
Denmark	-	15%	-	16%	2%
Hungary	18%	-	-	-	1%
Israel	-	-	-	-	-
Japan	39%	23%	-	6%	11%
Korea	1%	-	-	-	2%
Mexico	-	-	-	16%	37%
New Zealand	-	-	34%	-	-
Poland	21%	-	13%	-	-
Sweden	-	36%	-	48%	1%
Turkey	-	10%	22%	-	-
United Kingdom	-	15%	-	-	36%
United States	-	-	-	-	-

Note: Weights rounded to the nearest percent so may not sum to 100%. *Source*: Author's calculations

Table 3 shows the current account balance predictor means in the pre-EMU period (1980-1998) for Austria, France, Italy and Spain, and their synthetic counterparts. The far right hand column of the table shows the predictor means for the average of the entire donor pool.[9] Greece joined the EMU in 2001 so the pre-EMU period is longer for Greece than the other countries of interest. Table 4 shows the current account predictor means in the pre-EMU period (1980-2000) for Greece, Synthetic Greece and the average of the entire donor pool.

[9] I choose to present data on the donor pool as an unweighted average, rather than as a population-weighted average such as that used in Abadie et al. (2015). The latter approach would unduly weight the averages towards the larger countries in the sample (e.g. the US), which is not appropriate for my study, where the outcome variable is current account balance (as a % of GDP).

Table 3.
Current account balance predictor means in the pre-EMU period for Austria, France, Italy and Spain, their synthetic control units and the average of the donor pool: 1980-1998

	Austria	Synthetic Austria	France	Synthetic France	Italy	Synthetic Italy	Spain	Synthetic Spain	Donor pool average
GDP per capita (PPP, current international dollars)	19,236	13,622	18,252	16,871	18,530	17,083	14,196	13,029	13,492
Trade openness (%) = merchandise exports and imports as a share of GDP at current PPPs	74%	30%	49%	58%	40%	67%	34%	34%	42%
Domestic absorption growth (constant prices, 2005 $US, annual percentage change)	2.1%	2.4%	1.9%	2.3%	2.1%	1.9%	2.8%	2.8%	3.1%
Price level of exports (relative to US prices, price level of US GDP in 2005 = 1)	0.61	0.58	0.61	0.61	0.59	0.61	0.59	0.59	0.58
GDP growth (constant prices, annual percentage change)	2.2%	2.4%	2.1%	2.7%	1.9%	2.4%	2.7%	2.8%	3.3%
Total investment (as a % of GDP)	27%	26%	22%	24%	21%	22%	23%	23%	24%
Public debt (as a % of GDP)	60%	67%	44%	64%	105%	69%	52%	52%	63%
Government primary balance (as a % of GDP)	0.3%	0.6%	-1.0%	0.8%	2.9%	2.0%	-0.3%	1.3%	1.5%
Domestic credit to private sector (as a % of GDP)	93%	104%	85%	107%	55%	83%	75%	78%	73%
Current account balance (as a % of GDP)	-1.0%	-1.0%	0.2%	0.1%	-0.5%	-0.7%	-1.3%	-1.3%	-1.9%

Note: All variables are averaged for the 1980-1998 period. Except for: GDP growth (1981-1998), total investment (1984-1998), public debt (1986-1998), government primary balance (1990-1998) and domestic credit to private sector (1991-1998). The last column presents the unweighted average for the full donor pool.
Source: Author's calculations. See Table A1 in Appendix A for a list of sources for the underlying variables.

Table 4.
Current account balance predictor means in the pre-EMU period for Greece, Synthetic Greece and the average of the donor pool: 1980-2000

	Greece	Synthetic Greece	Donor pool average
GDP per capita (PPP, current international dollars)	13,796	13,298	14,218
Trade openness (%) = merchandise exports and imports as a share of GDP at current PPPs	32%	33%	43%
Domestic absorption growth (constant prices, 2005 $US, annual percentage change)	2.0%	3.2%	3.2%
Price level of exports (relative to US prices, price level of US GDP in 2005 = 1)	0.53	0.55	0.58
GDP growth (constant prices, annual percentage change)	1.6%	3.2%	3.4%
Total investment (as a % of GDP)	26%	24%	24%
Public debt (as a % of GDP)	82%	42%	62%
Government primary balance (as a % of GDP)	1.7%	1.6%	1.8%
Domestic credit to private sector (as a % of GDP)	32%	61%	75%
Current account balance (as a % of GDP)	-3.4%	-3.2%	-1.9%

Note: All variables are averaged for the 1980-2000 period. Except for: GDP growth (1981-2000), total investment (1984-2000), public debt (1986-2000), government primary balance (1990-2000) and domestic credit to private sector (1991-2000). The last column presents the unweighted average for the full donor pool.
Source: Author's calculations. See Table A1 in Appendix A for list of sources for the underlying variables.

We can see that the countries of interest are much closer to their synthetic counterparts on the majority of current account balance predictors than they are to the average of the donor pool, hence the synthetic control analysis produces better comparison units for the countries of interest than the simpler approach of averaging over the entire set of non-EMU OECD countries. In cases where current account balance predictors do not match closely this likely indicates the predictor receives a small weight in the calculation of the synthetic control unit—i.e. given the other predictors, the predictor does not have substantial power predicting the pre-EMU current account balance trajectory of the country of interest.[10]

Tables 3 and 4 show that there is a weighted average of OECD economies than did not join the EMU that can reproduce the economic attributes that determine the current account balances in the countries of interest before the introduction of the EMU. This is central to my confidence that any difference between the

[10] The weight each current account predictor takes in the minimization of Equation (1) is shown in Table A2 in Appendix A.

countries of interest and their synthetic counterparts in the post-EMU period can be interpreted as the causal effect of the EMU.

4.4. Empirical results

Fig. 1 shows the evolution of current account balances in my countries of interest and their synthetic counterparts between 1980 and 2010. The first thing to note is that the evolution of current account balances in the actual countries and their synthetic controls match closely before the introduction of the EMU. This satisfies the central assumption of the method, that the synthetic controls can closely track the movement of the actual data over the long pre-EMU period.

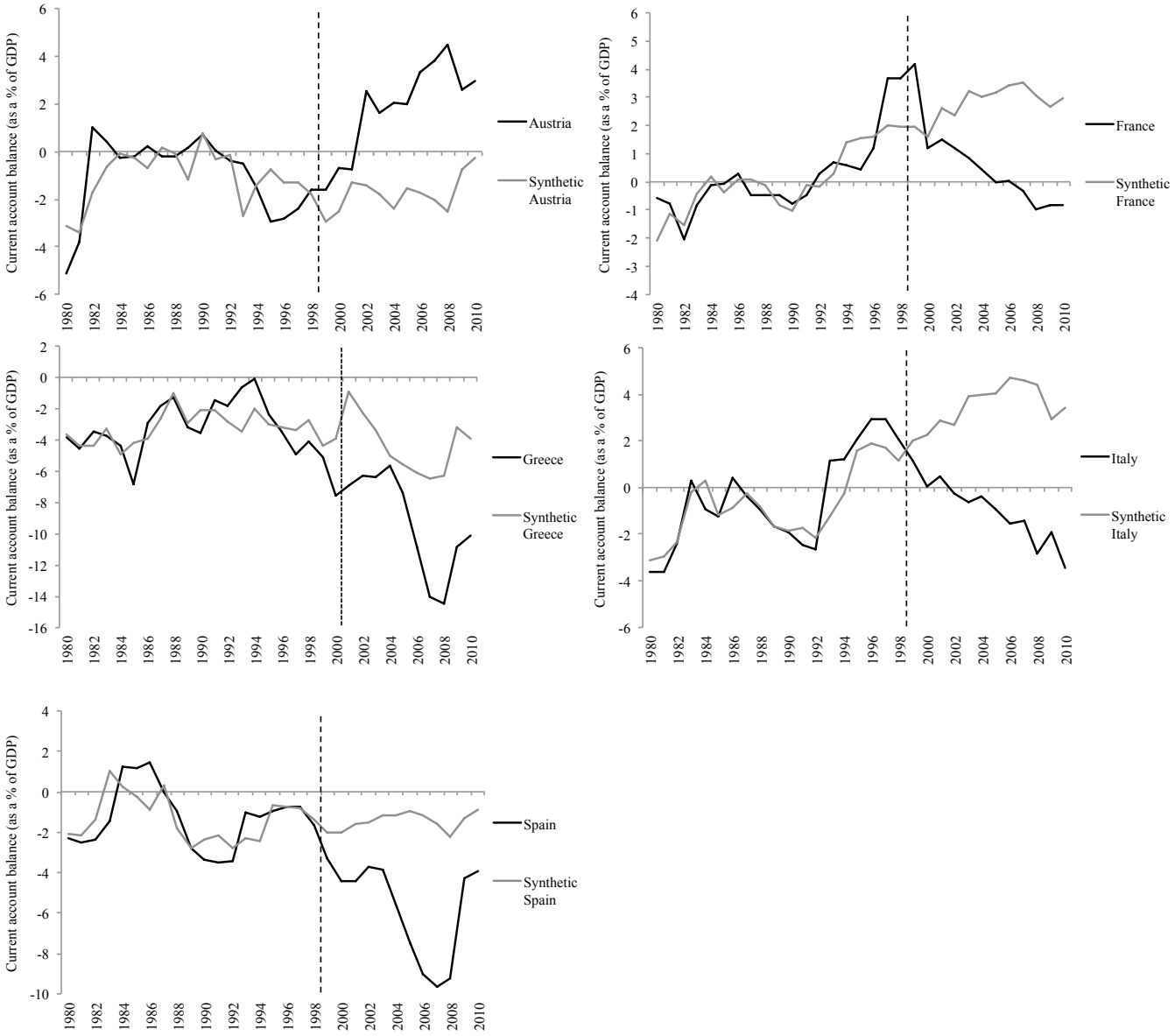


Fig. 1. Trends in current account balances (as a % of GDP) between 1980 and 2010: Austria, France, Greece, Italy and Spain vs. their synthetic control units.
Note: The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: IMF World Economic Outlook Database October 2015, and author's calculations.

In all five countries the trajectory of the country and its synthetic control diverge significantly after the EMU is introduced. In Austria, the actual current account moved dramatically into surplus in the post-EMU period, whereas Synthetic Austria remained in deficit. In the other four countries, actual current account balances deteriorated much more than the current account balances of the synthetic control units in the post-EMU period. Although the results do not cover all the EMU member states, they do provide strong empirical support for the hypothesis that the introduction of the EMU caused the current account balances of member states to diverge.

The causal effect of the EMU on current account balances is calculated as the gap between each country and their synthetic counterpart in the post-EMU period. Table 5 shows that the EMU had a significant negative effect on the current account balances of France, Greece, Italy and Spain. The average gap in the pre-EMU period was close to zero for all four countries but the post-EMU average gaps ranged between -2.3 percentage points in France and -5.0 percentage points in Greece. The opposite held in Austria, where the average post-EMU gap was 3.6 percentage points. The results imply that the EMU improved the current account position of Austria and worsened the current account position of France, Greece, Italy and Spain.

Table 5.
Average current balance gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain, and their synthetic control units in the pre- and post-EMU periods

	Average current account balance gap (in percentage points of GDP)				
	Austria	France	Greece	Italy	Spain
Pre-EMU	0.0	0.1	-0.2	0.3	0.0
Post-EMU	3.6	-2.3	-5.0	-4.5	-4.3

Note: The pre-EMU period runs from 1980-1998 for all countries except Greece, where it runs from 1980-2000. The post-EMU period runs from the year after the end of the pre-EMU period until 2010. *Source*: Author's calculations.

The causal effect of the EMU is plotted over time in Fig. 2. The figure shows that current account balance gaps grew over time during the first decade of the EMU, apart from a brief period in the early 2000s in Greece, and to a lesser extent Spain, that likely reflected the slowdown of these economies during the global slump of the early 2000s. The effect of the EMU peaks in Austria, Spain and Greece in 2007-08, just on the eve of the global financial crisis. The current account balance gaps in these countries then fell back (toward zero) as a result of the crisis. Italy and France's current account balance gaps were much less affected by the global financial crisis.

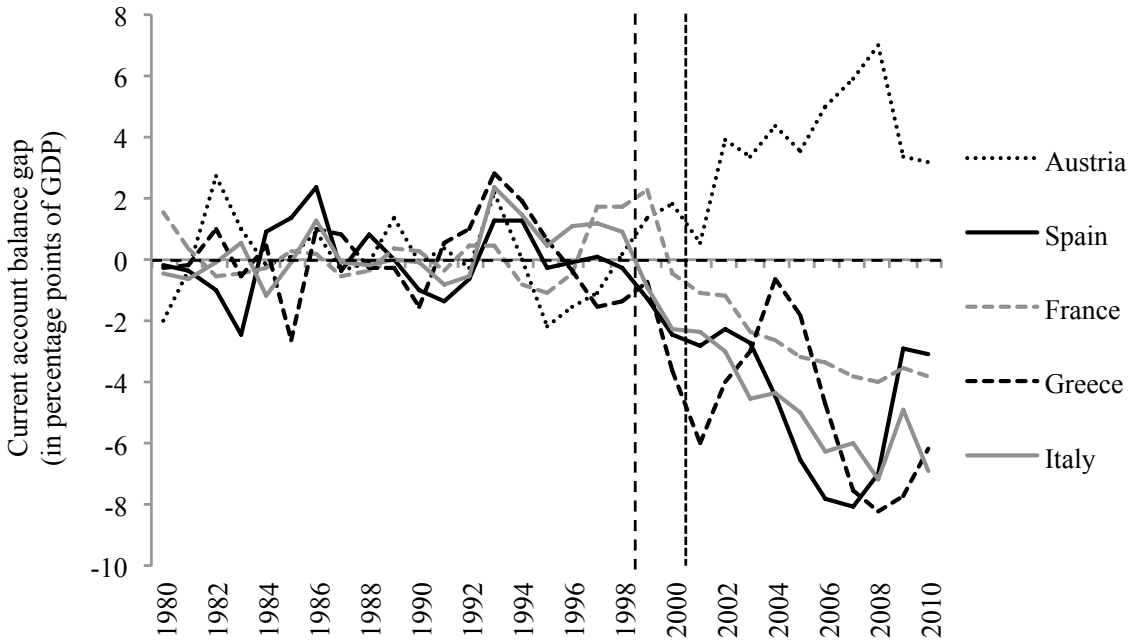


Fig. 2. Current account balance gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain and their synthetic control units: 1980 to 2010.
Note: The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: Author's calculations.

The synthetic control analysis cannot directly test the relative importance of the channels (or mechanisms) identified in the literature review in Section 2 in driving the current account imbalances but the results do provide some insights. There is a clear difference in the size of current account balance gaps (and underlying deficits) in the southern European countries at the onset of the global financial crisis; gaps (and deficits) were significantly larger in Greece and Spain than France and Italy (see Figs. 1 and 2). In addition, Greece and Spain had much less sustainable external debt positions (Fernandez-Villaverde et al., 2013) and experienced bigger falls in their current account gaps (and underlying deficits) when the global financial crisis hit (see Figs. 1 and 2). This fits with the financial integration channel playing a larger role in the Greece and Spain than elsewhere. Lane and Milesi-Ferretti (2012, 2010) show that abnormally large current account deficits, such as those fuelled by excessive domestic credit expansion, were associated with sharp current account reversals during the global financial crisis. The financial integration channel clearly intersected with the fiscal deficits channel in Greece, where the government grossly mismanaged the public finances and borrowed excessively on international debt markets (Featherstone, 2011; Katsimi and Moutos, 2010).

The competitiveness channel is likely to have affected all five of the countries. Greece, Italy and Spain countries do not possess the wage bargaining institutions to restrain wage growth and once they joined the EMU they could no longer devalue to regain competitiveness. In contrast, Austria belongs to the group of coordinated market economies (CMEs) in northern Europe that have coordinated wage bargaining that ties wage growth in the sheltered sector to that in the export sector (Johnston and Hancké, 2009; Johnston et al., 2014). France sits somewhere in between; it can to some extent limit wage growth through state-imposed wage coordination (Johnston et al., 2014), but it is much less export-orientated than the northern European

CMEs and often grouped with the southern European economies as a mixed market economy in the Varieties of Capitalism literature (Hall, 2014; Iversen et al., 2016). It is well documented, however, that France saw its cost competitiveness vis-à-vis Germany (its biggest export competitor) deteriorate during the 2000s (Bouchoucha, 2015; Kierzenkowski, 2009). The introduction of the EMU in a set of countries with different wage-setting institutions led to a divergence in real unit labor costs and consequently current account balances (Carlin, 2013; De Grauwe, 2013; Johnston et al., 2014). The north–south competitiveness differential is likely to take time to correct because wages are downwardly rigid and can often only be adjusted gradually (Bertola et al., 2013), and because efforts to improve relative competitiveness in the south are slowed by continued wage restraint in the north (Brancaccio, 2012). This could be one potential reason why the current account balance gaps in Italy and France, where the competitiveness channel is likely to have been relatively more important, were largely unaffected during the global financial crisis.

The main results of the synthetic control analysis provide ample empirical evidence that the EMU drove the accumulation of current account deficits in the southern European economies prior to the euro crisis. While only one northern European surplus country is directly tested in my analysis, I believe the Austrian result implies that the EMU also drove the imbalances across the northern Europe surplus economies. The northern European CMEs share distinct political-economic institutions and wage bargaining systems and are driven strategically by export-orientation (Hall, 2014; Iversen et al., 2016); and like Austria, the other northern CMEs saw their real units labor costs and current account balances diverge from those of the southern European economies during the 2000s (Carlin, 2013; De Grauwe, 2013). Hence, the main results of the study provide empirical evidence that the EMU caused the current account imbalances not just in my countries of interest but across the euro area as a whole.

5. Placebo and robustness tests

The results presented so far suggest that the EMU drove the current account imbalances between member states in the run-up to the euro crisis. It is important to carry out further tests, however, before we can be confident in the credibility of the findings of the synthetic control analysis. Sections 5.1 to 5.4 report the results of a selection of placebo and robustness checks to test the internal validity of my results.[11] As an additional robustness test, I also re-estimate the main results using a panel difference-in-differences design in Section 5.5.

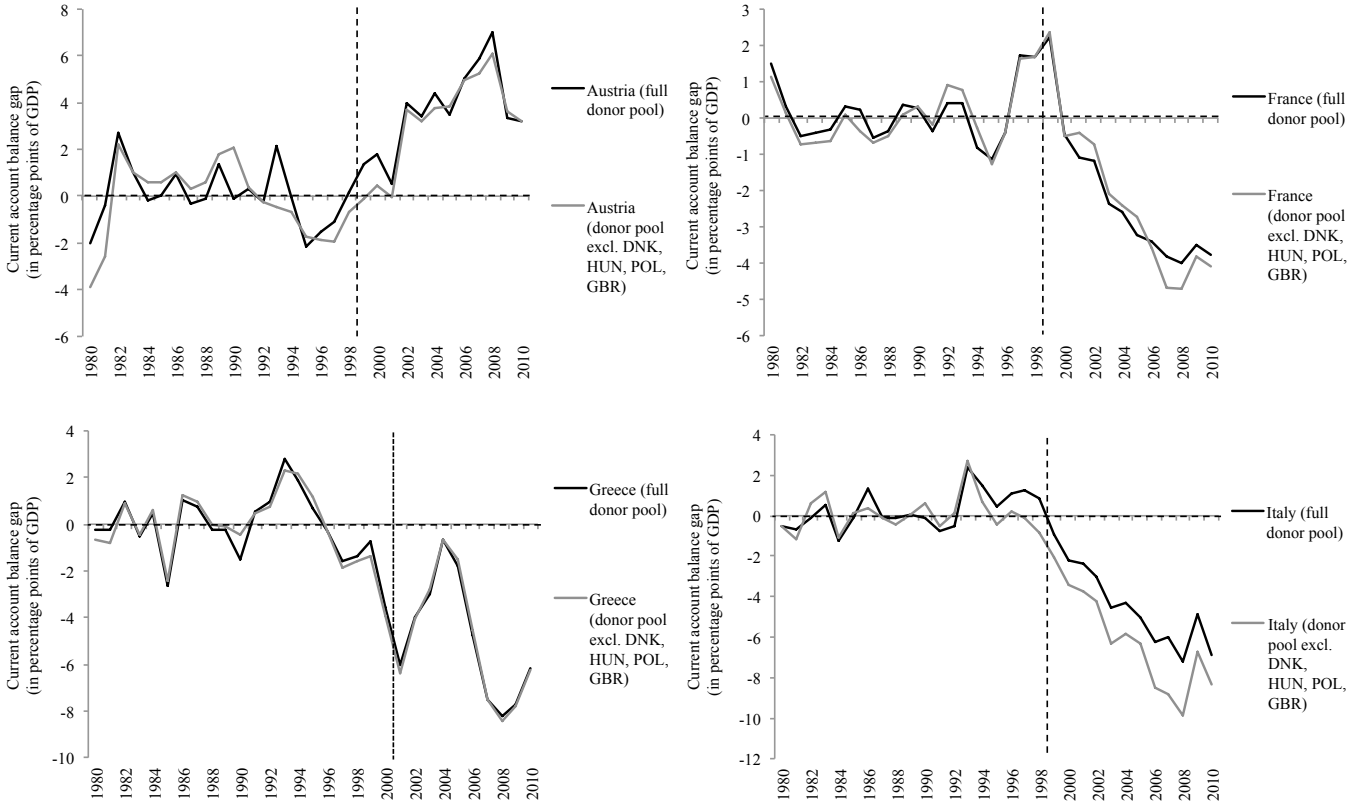
5.1. Spillovers robustness test

One potential bias in this study could be if there were spillovers to the current account balances of the countries in the donor pool from the introduction of the single currency. For example, if the EMU altered patterns of trade outside of the euro area. The presence of spillovers would violate the Stable Unit Treatment

[11] The placebo and robustness tests in Sections 5.2 to 5.4 are the same as those used in Abadie et al. (2015).

Value Assumption (SUTVA), which assumes that there are no interferences between units (Rubin, 1980). SUTVA violations should be small in my case because by design the countries that form the synthetic control were not part of the EMU, and therefore did not have their exchange rates irrevocably fixed to the EMU members states during the post-EMU period. In addition, as the control countries were outside the EMU, their transactions costs from trade and their currency risk on cross-border banking flows were not reduced in the same way as my countries of interest by the introduction of the single currency.

It is, however, difficult to rule out spillovers completely in countries that traded a lot with EMU member states during the post-EMU period. It is theoretically unclear in which direction spillovers would bias my results, especially as the donor pool contains both current account surplus and deficit countries, but in order to allay any fears they may be driving the results of the synthetic control analysis, we re-run the analysis excluding the four countries that traded the most with the euro area during the post-EMU period. This results in the removal of two middle-income countries, Hungary and Poland, and two high-income countries, Denmark and the UK, from the donor pool.[12] We limit the removal to four countries because we need to ensure the donor pool is still sufficiently large to produce good synthetic control units. Fig. 3 shows that the main results are robust to the removal. In fact, the estimated effect of the EMU in Italy and Spain is slightly larger without these countries in the donor pool, suggesting that if spillovers are present, they are actually leading to an underestimation of the EMU's effect in these two countries.



[12] The donor pool countries were ranked according to the average proportion of total trade (exports + imports) that occurred with euro area countries over the post-EMU period (1999-2010). *Source*: IMF Direction of Trade Statistics, December 2015.

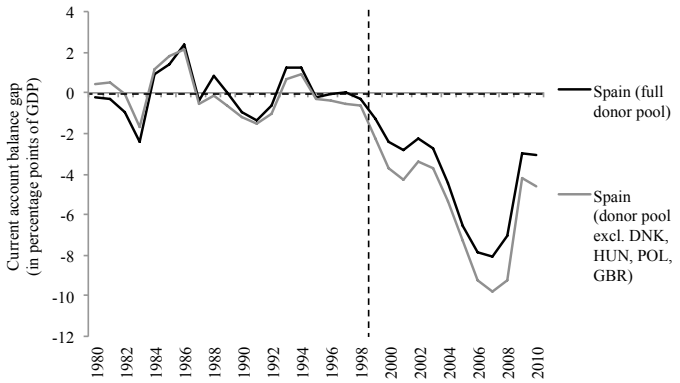


Fig. 3. Current account balance gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain, and their synthetic control units, with full donor pool and donor pool excluding Denmark, Hungary, Poland and the UK: 1980 to 2010.
Note: The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: Author's calculations.

5.2. In-time placebos

The next set of tests is the in-time placebos, which reassigns the event of interest (i.e. the introduction of the EMU) to a period before it actually took place. A large EMU effect could undermine the credibility of the main results. In my study, the pre-EMU period for Austria, France, Italy and Spain runs for 19 years; hence I reassign the EMU to 1990 for these countries, which is the middle of the period and nine years before the euro was actually introduced. As Greece joined the EMU in 2001, their pre-EMU period runs for two more years. I therefore reassign the introduction of the EMU to 1991 in the Greek analysis.

The next step is to carry out exactly the same synthetic control analysis as before but using the altered time periods.[13] Figs 4 and 5 show that the current account balance gaps for all countries except Italy are small in both the pre- and post-euro periods and fluctuate around zero, indicating the placebo introduction of the EMU has no significant effect on current account balances. In Italy, the placebo shows a positive current account balance gap opening up prior to the actual introduction of the EMU. However, this does not undermine the main results, because Italy was a deficit country during 2000s, hence to the extent to which these pre-EMU effects were present, they would likely lead to an underestimation of the EMU effect in Italy in the main results.

Taken together, the results of the in-time placebos suggest that the current account balance gaps in the main results are driven by the introduction of the EMU and not the inability of the synthetic control units to replicate actual current account balances.

[13] The only change in the specification in Austria, France, Italy and Spain is that the government primary balance and domestic credit to the private sector are dropped as predictors because no data is available during the 1980-1989 period. As the government primary balance is available from 1990, only domestic credit to the private sector is dropped in the Greek analysis.

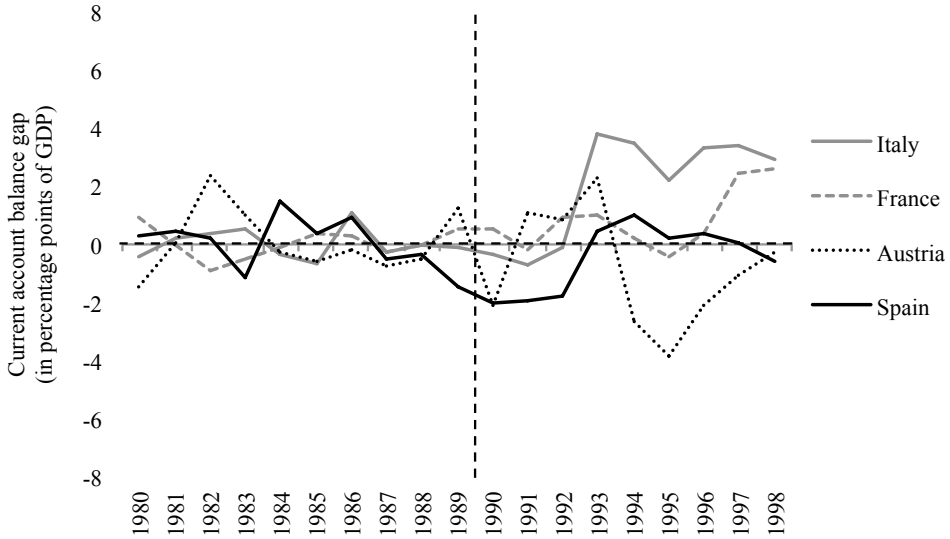


Fig. 4. Placebo EMU introduction in 1990: Current account balance gaps (in percentage points of GDP) between Austria, France, Italy and Spain, and their synthetic control units: 1980 to 1998.
Note: The vertical dotted line marks the date of the placebo EMU introduction (1990). *Source*: Author's calculations.

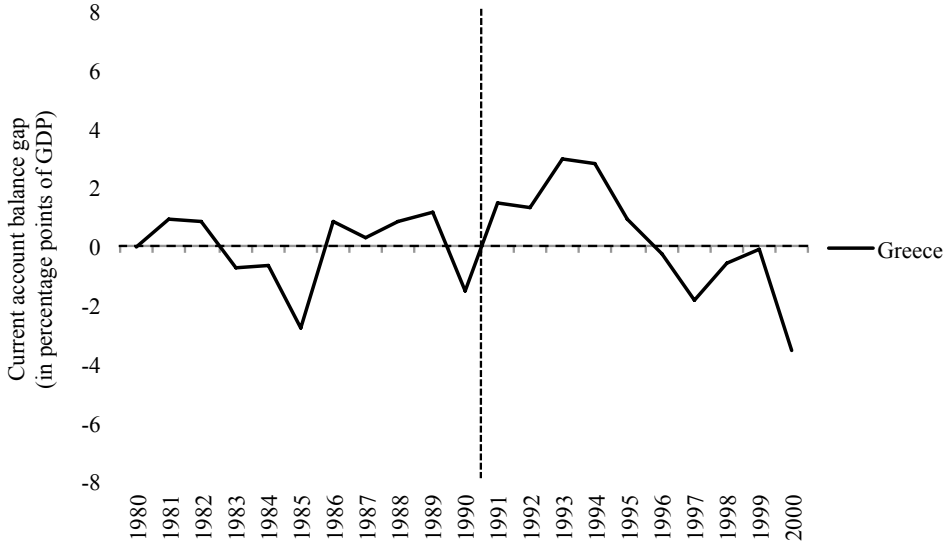


Fig. 5. Placebo EMU introduction in 1991: Current account balance gap (in percentage points of GDP) between Greece and Synthetic Greece: 1980 to 2000.
Note: The vertical dotted line marks the date of the placebo EMU introduction (1991). *Source*: Author's calculations.

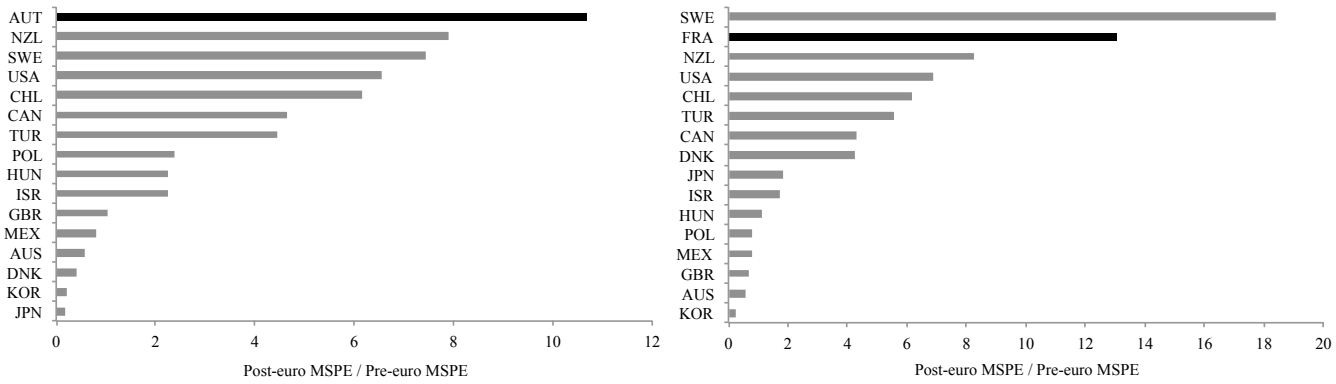
It is evident that the eventual EMU member states knew about the currency union well in advance of 1999, and that the member state governments pursued restrictive macroeconomic policies during the 1990s in order to achieve the Maastricht convergence criteria (a set of targets for macroeconomic indicators) required to join the single currency. The in-time placebo tests, however, help to dispel fears of anticipatory effects invalidating the results of the synthetic control analysis, because they show that the EMU had no significant effect on the current account balances of my countries of interest (excluding Italy) before the introduction of the EMU. One potential reason for this could be that the 1990s saw macroeconomic management in advanced economies shift towards independent, inflation-targeting central banking, hence

the non-euro OECD countries that make up the synthetic control units were pursuing similarly tight macroeconomic policies to my countries of interest during latter part of the pre-EMU period.

5.3. Across-country placebos

The second type of placebo study I carry out is an across-country placebo. This reassigns the introduction of the EMU to countries in the donor pool one at a time, providing a distribution of placebos effects (i.e. the effect of adopting the single currency) for OECD countries in my sample that did not participate in the EMU. If my baseline results are credible, then the effect of the EMU should be significantly larger for my countries of interest than countries in the donor pool. The across-country placebo must be carried out separately for the five countries in my study. For each country of interest, the synthetic control method must be carried out 15 times, each time reassigning the event of interest to a different country in the donor pool (and dropping the relevant country of interest into the donor pool).

The results of the across-country placebo are best interpreted by comparing ratios of the post-EMU mean squared prediction error (MSPE) to the pre-EMU MSPE, as shown in Fig. 6. The MSPE is a measure of the closeness of fit between a country's actual current account balance and that of its synthetic control. The MSPE ratio is higher when the effect of the EMU on the current account balance is larger. However, the measure also takes into account how well the synthetic control for each country can approximate the pre-EMU trend in current account balances. A large current account balance gap in the post-EMU period is not strong evidence of the EMU having a large effect if the synthetic control unit does not closely match the current account balance of the country of interest in the pre-EMU period. Put another way, a high post-EMU MSPE is not indicative of the EMU having a large effect on the current account balance when the pre-EMU MSPE is also large.



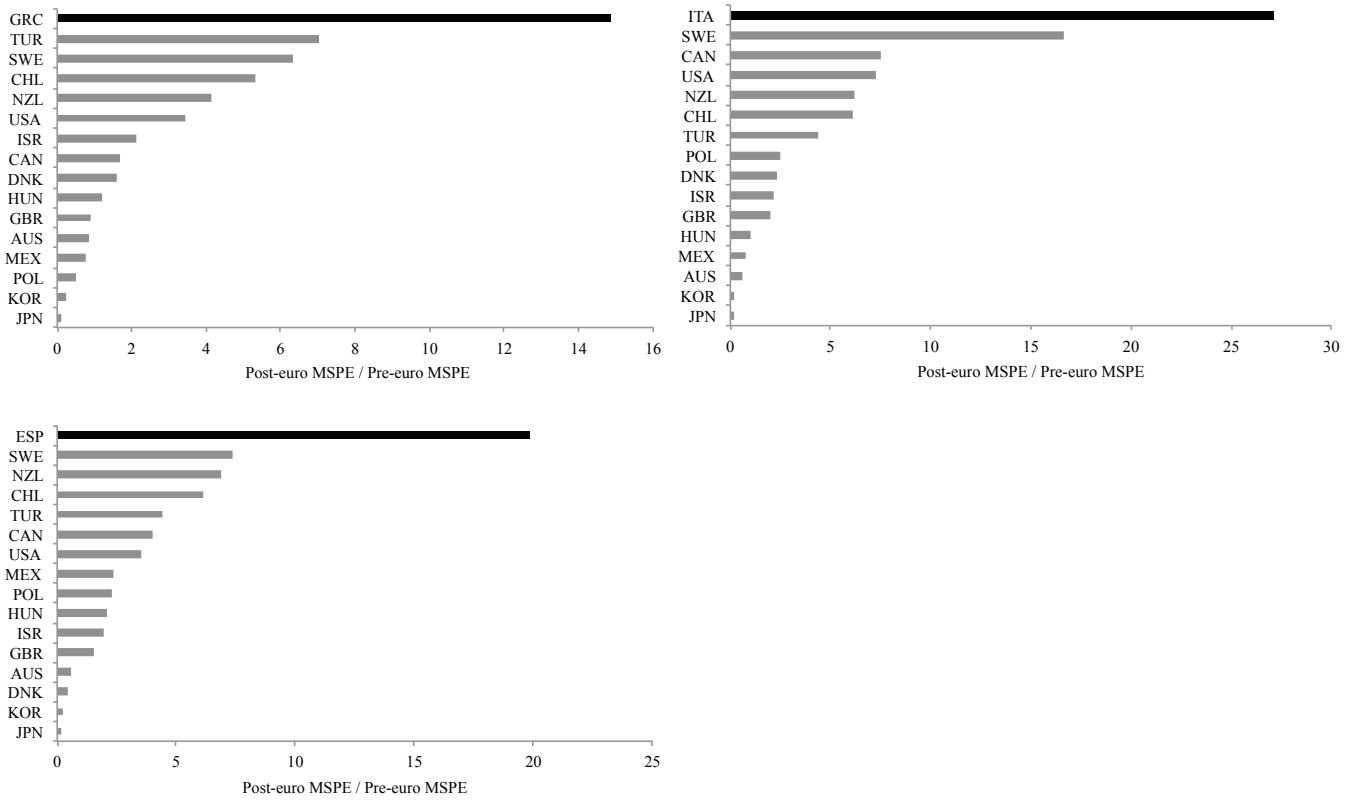


Fig. 6. Ratio of post-EMU MSPE to pre-EMU MSPE: Austria and donor pool, France and donor pool, Greece and donor pool, Italy and donor pool, and Spain and donor pool.
Note: The pre-EMU period runs from 1980-1998 for all countries except Greece, where it runs from 1980-2000. The post-EMU period runs from the year after the end of the pre-EMU period until 2010. *Source*: Author's calculations.

Austria, Greece, Italy and Spain have by far the largest post- to pre-EMU MSPE ratio of the 16 countries in their respective samples. We can use the distribution of ratios to compute a p-value (as in Abadie et al., 2015, p. 11). If the null hypothesis (that the EMU has no effect) was true, the chances of obtaining a ratio as high as the one observed for Austria, Greece, Italy and Spain would be just 1/16 or 0.0625. The MSPE ratio in France is the second highest in the sample to Sweden, which means the French p-value is 2/16 or 0.125. However, Synthetic Sweden is overwhelmingly dependent on France (it receives a 79% weight in the synthetic control) and hence the Swedish result is not robust to the type of test carried out in the next section.

I can use the p-values calculated for my countries of interest and Fisher's (1932) combining function to calculate a combined p-value across my five independent studies.[14] The joint null hypothesis is that all of the separate null hypotheses are true (i.e. that the EMU has no effect on current account balances in all five countries). The overall p-value from my synthetic control analyses is 0.00120, which is highly statistically significant at any conventional level. Taken together, the p-values from my synthetic control analysis therefore suggest that the main results of the study are very unlikely to have been driven by chance.

[14] The combined test statistic is calculated as $-2\sum_{i=1}^{k}\ln(p_i)$, which has a χ^2 distribution with $2k$ degrees of freedom, where k is the number of independent tests being combined.

5.4. Leave-one-out robustness test

The leave-one-out robustness test is to assess whether the baseline results are sensitive to the removal of any one country from the synthetic control units. This is to avoid the case where the results are driven by one country. Carrying out the robustness test for a country of interest involves re-running the synthetic control analysis a number of times, each time leaving out one of the countries that make up the synthetic control unit. For example, Synthetic Austria is made up of Australia, Hungary, Japan, Korea and Poland. The test involves removing each of these five countries in turn from the donor pool and re-calculating the synthetic control analysis. The results of the test are shown in Fig. 7.

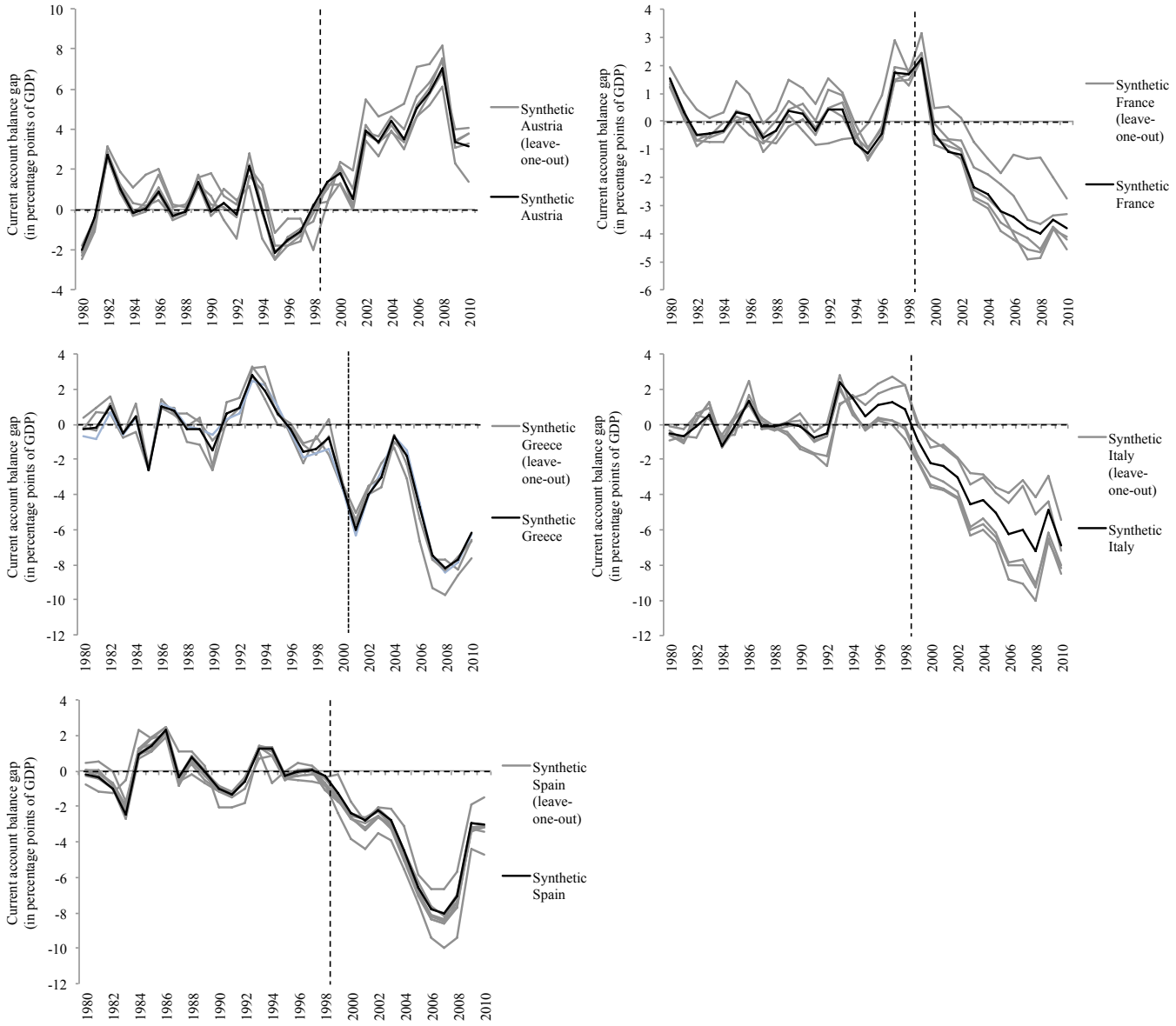


Fig. 7. Robustness test: Leave-one-out distribution of the gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain, and their synthetic control units: 1980 to 2010.
Note: The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: Author's calculations.

The results of the main synthetic control analysis are robust to the exclusion of any one country from the synthetic control units. In other words, the current account balance gaps are very similar between the synthetic control units and the leave-one-out synthetic control units. The French and Italian tests do show some variation in the size of the current account balance gaps but the main qualitative result still holds up; the EMU led to a significant deterioration in current account balances in both countries. Taken together, the leave-one-out robustness tests provide evidence that one particular country is not driving the main results of my study.

5.5. Panel difference-in-differences results

The final robustness test in the paper is to re-estimate the results using a panel difference-in-differences design. If the results are comparable those of the synthetic control analysis, it adds further credibility to the main results of my study. I estimate two models using the same dataset as the synthetic control analysis. The dataset includes my five countries of interest and the fifteen donor pool countries and covers 1980-2010. In both models the dependent variable is current account balances (as a % of GDP) and the independent variables of interest are an EMU dummy, which is one for my five countries of interest from 1999-2010 and zero otherwise, and an interaction term, which interacts an Austria dummy (1 for Austria and zero otherwise) and the EMU dummy. The interaction is included because the synthetic control results show that the EMU effect in Austria (large and positive) was very different from the other four countries of interest (large and negative). Model 1 then includes both country and year fixed effects; and Model 2 further adds the full set of current account predictors (covariates) used in the synthetic control analysis. I use two-way clustered standard errors to account for dependencies between observations both within countries and within time periods. Table 6 reports the results of the panel difference-in-differences estimation.

Table 6.
The effect of the EMU on current account imbalances: Panel difference-in-differences estimates

Model	(1)	(2)
EMU	-3.50 **	-2.69 **
	(1.52)	(1.07)
	[0.021]	[0.011]
Austria * EMU	5.43 ***	2.28 **
	(1.51)	(1.12)
	[0.000]	[0.041]
Observations	620	593
R -squared	0.15	0.36
Country fixed effects	✓	✓
Year fixed effects	✓	✓
Covariates	✗	✓

Note: This table shows the coefficients from panel difference-in-differences regressions. The two-way clustered standard errors are shown in parentheses and the p-values are shown in brackets; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The dependent variable is current account balance (as a % of GDP). The standard errors are two-way clustered by country and year.

The results show that the EMU exerted a statistically significant negative effect on the current account balances of the five EMU member states in the sample. The statistically significant interaction term shows a large countervailing EMU effect in Austria. The coefficients in Model 1 are of a comparable size to those in the synthetic control analysis (see Table 5). The coefficients in Model 2 are somewhat smaller but are still statistically significant and have the expected signs. The results of both models therefore corroborate the main findings of the synthetic control analysis.

6. Conclusion

The European sovereign debt crisis put severe economic and political strain on the EMU and prompted a reassessment of the EMU's supposedly successful first decade. This turned the spotlight onto the substantial macroeconomic imbalances that emerged between member states after the introduction of the euro, and the divergence in current account balances in particular.

This paper investigates the extent to which the introduction of the EMU was responsible for the current account imbalances that arose between member states. More specifically, I use macroeconomic data from OECD countries and a counterfactuals-based approach—the synthetic control method—to estimate the causal effect of the EMU on the current account balances of individual member states. This paper contributes to the empirical literature on the effect of EMU on current account balances, which has yet to come to a consensus about whether the imbalances were caused by the EMU (Belke and Dreger, 2013; Campa and Gavilan, 2011; Schmitz and von Hagen, 2011) or by factors external to the currency union (Chen et al., 2013; Guerrieri and Esposito, 2013). The synthetic control approach is ideally suited to fill this

gap in the literature as it shows us what would have happened to the current account balances of member states had they not joined the EMU.

The results of the study show that the introduction of the single currency caused a significant deterioration in the current account balances of France, Greece, Italy and Spain, and significantly improved the current account position of Austria. The similarity of political-economic institutions across the northern European CMEs, as well as comparable trends in real exchange rates and current account balances during the 2000s, suggests that the Austrian result is also likely to hold in the other northern European CMEs. In other words, the EMU is likely to have caused the accumulation of current account surpluses across the northern European CMEs. The main results of my study therefore imply that the EMU drove the current account imbalances not just in my countries of interest but across the whole euro area.

Policymakers in the euro area have started to pay more attention to external imbalances in the wake of the euro crisis. The European Commission's Macroeconomic Imbalances Procedure (MIP) aims to identify and correct macroeconomic imbalances, including those in the current account.[15] However, the results of my study provide reason to be skeptical about whether the MIP will succeed in achieving its goals. I find the EMU drove the imbalances, and hence changes to the EMU's institutional framework, and not just better monitoring of external balances, may be required to avoid the imbalances reemerging in the future. In addition, my results suggest that policy intervention, such as, for example, fiscal devaluation (see Bertola et al., 2013), is likely to be necessary to close the competitiveness gap that opened up between the north and south during the 2000s, especially given continued wage moderation in the north.

This paper makes a valuable contribution to the large body of empirical literature on the macroeconomic effects of the EMU by providing causal evidence that the EMU drove the euro area's current account imbalances. The analysis suggests that the EMU effect operated through multiple channels, but it is clear that we still require a better understanding of the underlying mechanisms if the next generation of euro area policymaking is to successfully safeguard the EMU from dangerous external imbalances. I therefore expect a more thorough analysis of the channels through which the EMU affects current account balances, and how their influence can be mitigated, to be a fruitful and important avenue for future research.

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[15] For more information on the Macroeconomic Imbalances Procedure see: http://ec.europa.eu/economy_finance/economic_governance/macroeconomic_imbalance_procedure/index_en.htm

Appendix A

Table A1.
Variable definitions and data sources

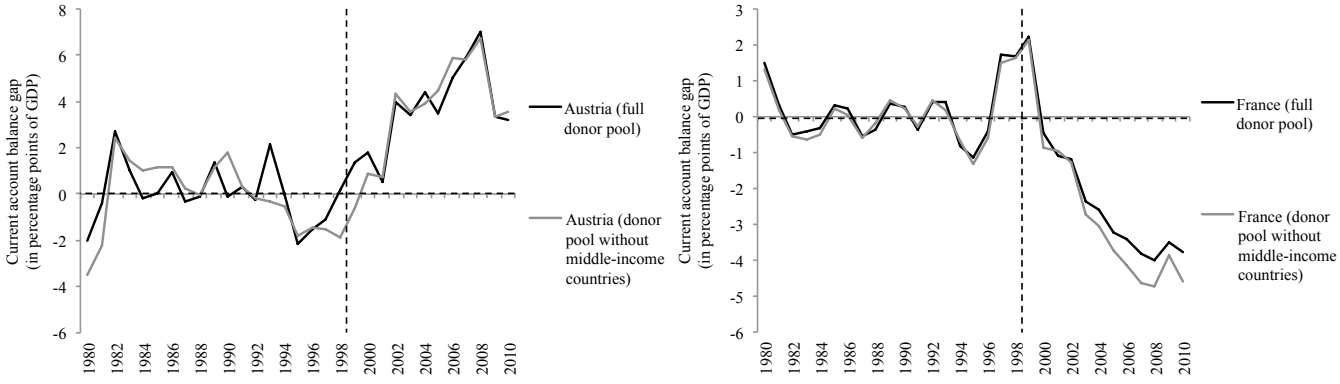
Variable	Data source
GDP per capita (PPP, current international dollars)	IMF World Economic Outlook Database, October 2015
Trade openness (%) = merchandise exports and imports as a share of GDP at current PPPs	Penn World Tables 8.1 Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review*, 105(10): 3150-82, available for download at www.ggdc.net/pwt
Domestic absorption growth (constant prices, 2005 $US, annual percentage change)	Penn World Tables 8.1 Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review*, 105(10): 3150-82, available for download at www.ggdc.net/pwt
Price level of exports (relative to US prices, price level of US GDP in 2005 = 1)	Penn World Tables 8.1 Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review*, 105(10): 3150-82, available for download at www.ggdc.net/pwt
GDP growth (constant prices, annual percentage change)	IMF World Economic Outlook Database, October 2015
Total investment (as a % of GDP)	IMF World Economic Outlook Database, October 2015
Public debt (as a % of GDP)	IMF Historical Public Debt Database, September 2012 Abbas, S.M. Ali, Nazim Belhocine, Asmaa El-Ganainy and Mark Horton (2010) "A Historical Public Debt Database", IMF Working Paper WP/10/245, Washington, DC, available for download at https://www.imf.org/external/pubs/cat/longres.aspx?sk=24332.0
Government primary balance (as a % of GDP)	IMF Historical Public Finance Dataset, 2013 Paolo Mauro, Rafael Romeu, Ariel Binder and Asad Zaman, 2013, "A Modern History of Fiscal Prudence and Profligacy," IMF Working Paper No. 13/5, International Monetary Fund, Washington, DC, available for download at http://www.imf.org/external/np/fad/histdb/
Domestic credit to private sector (as a % of GDP)	World Bank World Development Indicators, March 2015
Current account balance (as a % of GDP)	IMF World Economic Outlook Database, October 2015

Table A2.
Weights for current account balance predictors in synthetic control units

	Synthetic control unit				
	Austria	France	Greece	Italy	Spain
GDP per capita (PPP, current international dollars)	-	7.1%	17.8%	0.1%	0.4%
Trade openness (%) = merchandise exports and imports as a share of GDP at current PPPs	-	0.7%	25.7%	1.0%	11.5%
Domestic absorption growth (constant prices, 2005 $US, annual percentage change)	0.1%	1.8%	0.7%	11.3%	10.3%
Price level of exports (relative to US prices, price level of US GDP in 2005 = 1)	0.4%	47.5%	8.1%	-	5.7%
GDP growth (constant prices, annual percentage change)	11.1%	1.8%	0.7%	28.3%	19.9%
Total investment (as a % of GDP)	50.5%	0.2%	1.6%	27.4%	17.9%
Public debt (as a % of GDP)	3.9%	1.4%	-	2.8%	12.2%
Government primary balance (as a % of GDP)	4.5%	1.2%	41.9%	-	-
Domestic credit to private sector (as a % of GDP)	2.3%	1.8%	-	0.3%	5.4%
Current account balance (as a % of GDP)	27.2%	36.5%	3.6%	28.9%	16.6%

Source: Author's calculations.

Appendix B



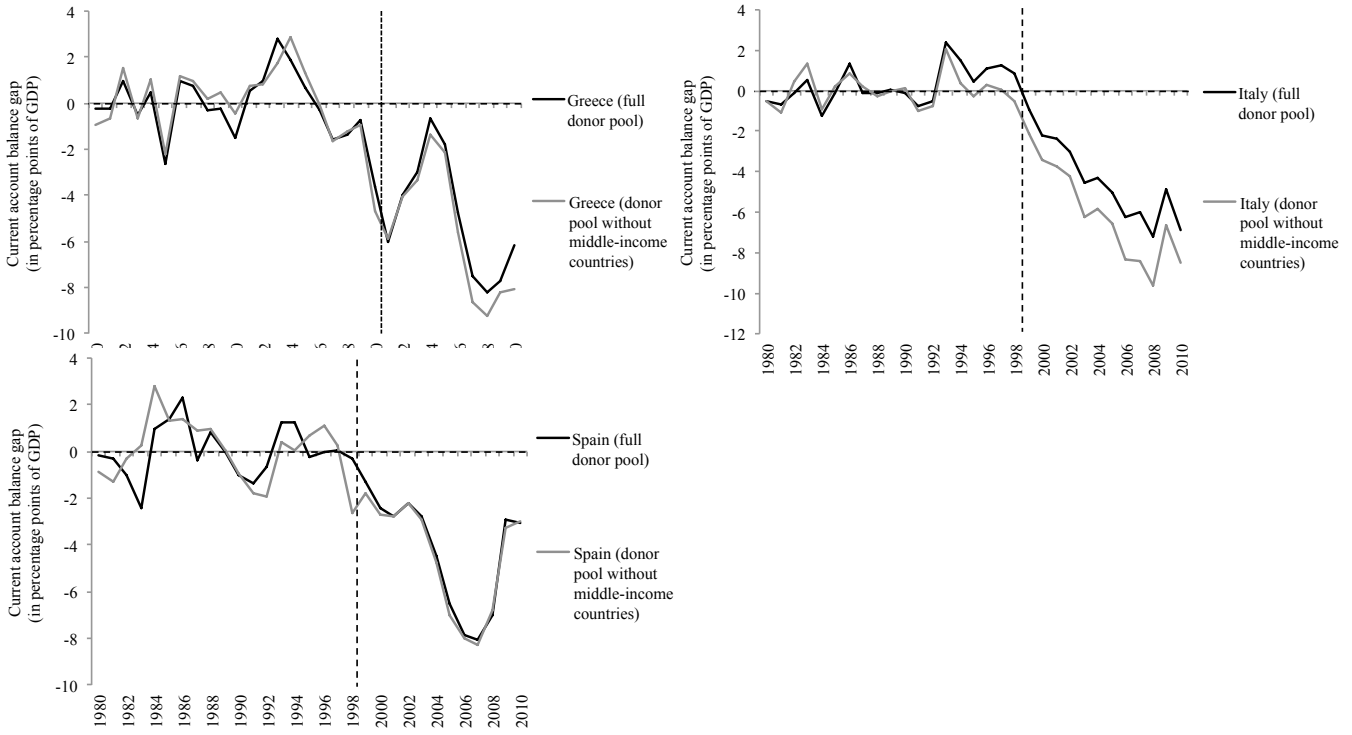
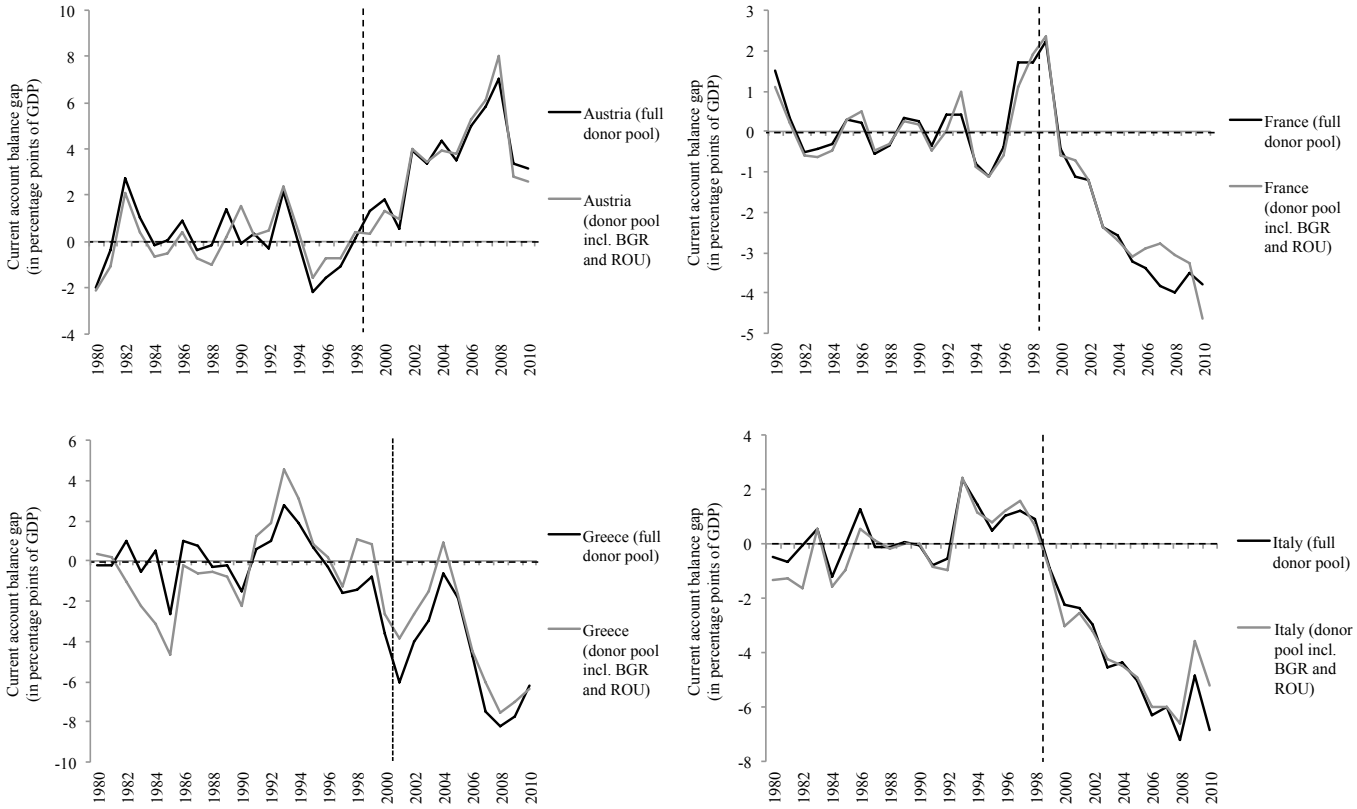


Fig. B1. Current account balance gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain, and their synthetic control units, with full donor pool and donor pool excluding middle-income countries: 1980 to 2010.

Note: The middle-income countries in the sample are Chile, Hungary, Mexico, Poland and Turkey. The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: Author's calculations.



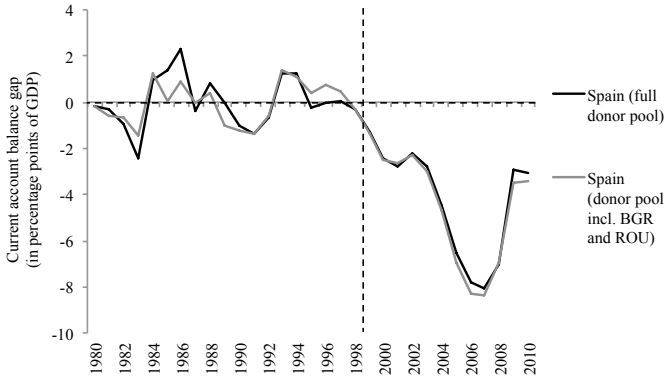


Fig. B2.

Current account balance gaps (in percentage points of GDP) between Austria, France, Greece, Italy and Spain, and their synthetic control units, with full donor pool and donor pool including Bulgaria and Romania: 1980 to 2010. Note: Bulgaria and Romania have poor data availability for some current account predictors, therefore public debt is only included in the analysis from 1992, the government primary balance is only included from 1995 and domestic credit to the private sector is only included from 1996. The vertical dotted lines show when countries joined the EMU. All countries joined in 1999 except Greece, which joined in 2001. *Source*: Author's calculations.

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